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AUTHOR Lewallen, Martha
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ABSTRACT

Articles and documents concerning brain growth and hemispheric specialization, theories of cognitive style, educational implications of brain research, and right-brain learning activities are cited in this annotated bibliography. Citations are preceded by a glossary of terms and followed by a brief review of the assembled literature. Educational implications and recommendations are extracted from the review. In conclusion, thirteen classroom techniques for stimulating the right brain are listed and briefly described. (RH)

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AN ANNOTATED BIBLIOGRAPHY OF THE LITERATURE DEALING WITH THE INCORPORATION OF RIGHT BRAIN LEARNING INTO LEFT BRAIN ORIENTED SCHOOLS

BY

MARTHA LEWALLEN

Graduate Student

A Study Directed

by

Charles R. DuVall, Ph.D.

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INTRODUCTION

For the last thirty years information from research into man's cognitive processes has proliferated. Much of what is now known about brain functioning comes from neurological reports on brain injured persons. This information demonstrates that the cerebral cortex is divided into two hemispheres connected by the corpus callosum. (Yellin)

Early research into the functions of each side of the brain suggested that the left hemisphere specialized in verbal and analytic thought processes while the right was spatial and intuitive. (Galin) Later evidence took exception to this idea of absolute hemispheric specialization. Roger Sperry's work showed that when one hemisphere was injured, the other hemisphere could be taught to take over some of the skills of the injured side. (Yellin) Research also indicated that the brain halves could function simultaneously as well as independently. When they complemented one another, man accomplished his highest achievement. (Ornstein)

STATEMENT OF THE PROBLEM

Young children, it has been determined, examine the world on a perceptual basis. (Rennels) In addition subcultures in the United States, including the urban poor, tend to use a spatial mode of learning. (Galin) A study of elementary school students conducted by Reynolds, Kaltsounis, and Torrance in 1978 demonstrated that low ability students preferred either a left hemisphere orientation or a right hemisphere orientation to their

learning. On the other hand, the gifted students preferred an integrated style. (Shannon and Rice) Programs of the 1960's indicated that children deprived of "visual and sensory stimuli have lower intellectual capabilities." (Rennels) Despite this evidence schools focus almost exclusively on the left half of the brain, thus handicapping many, perhaps all, of the students. (Galyean, 1981)

PURPOSE OF THE STUDY

Educators are responsible for developing the whole child. Yet many were trained before much of this brain research was conducted or disseminated. If, as has been suggested, this research promises an exciting revolution in education, (Hatcher) it is essential that the information reach the elementary teachers who have the responsibility and challenge of starting children on a lifelong adventure in learning.

ORGANIZATION OF THE STUDY

In order to develop a rationale, it seems necessary to address three important questions. (1) How does the brain grow and function? (2) What is the effect of the schools' one-sided approach to learning on the students? (3) What can educators do to remedy the current situation?

To answer these questions, this study will be divided into four sections. The first will review the research regarding brain growth and hemispheric specialization.

Second it is necessary to understand the rationale for providing a holistic education. Therefore a review of the research on learning styles' theories will be presented. In the third section the educational implications derived from the previous two areas will be discussed. Finally, it is important to develop curricula and materials which promote this holistic education. Until these are available educators can at least incorporate right brain activities into their programs. The last section of this study will provide general right brain activities for the elementary school classroom. Specific activities will be included in an appendix to this study.

LIMITATION OF THE STUDY

There was an abundance of research and opinion on brain functioning and learning style theories but much less on right brain activities. Time limitations necessitated restricting the study. Therefore the research was limited mainly to that published during the last five years with the inclusion of some of the notable earlier research to demonstrate the growth in this area of study. Sample activities were limited primarily to the areas of reading, since it is basic to education, and social studies, because it was an area of particular interest.

It is hoped that the few sample activities listed for other areas will encourage teachers to create their own right brain strategies. [Other activities can be found in the Oklahoma State Department of Education Study Guide.]

GLOSSARY

alpha waves - electrical brain impulses that are slow (8 to 12 H_z) but with high amplitude. They occur "when a person is quiet, relaxed and yet aware of his surroundings, the optimal condition for learning." (Yellin 1983:39)

bilateral - "each hemisphere shares some functions," but processes the information differently. (Hatcher, 1983:9)

biofeedback - the use of monitoring instruments to detect the body's physiological processes and to make the information available to the person involved. (Yellin 1983:38)

brain-stem - that portion of the brain located atop the spinal cord which controls basic life processes such as respiration and circulation. (Rose 1982:48)

cognitive (learning) style - "the consistent way an individual acts, reacts, and adapts to the environment." (Kuchinskas 1979:269)

commissurotomy - "surgical severing of the corpus callosum." (Myers 1982:198)

confluent imagery - "the use of imagery in two or more ways." (Galyean 1983:57)

corpus callosum - "a bridge of nerve fibers that connects the two hemispheres" of the brain. (Galin 1976:20)

creativity - "the production of material or relationships new to the culture." (Gowan 1979:39)

dendrite - part of the neuron which conducts sensory information into the cell body. (Galyean 1981:6)

endorphins - hormones secreted by the thalamus gland "which anesthetize the other glands thereby blocking the passage of new information into the neo-cortex." (Galyean 1981:7)

hemisphericity - "the tendency for a person to rely more on one than the other cerebral hemisphere in processing information." (Torrance 1982:29)

hertz cycles - a measurement of the periodic electrical waves within the brain. (Yellin 1983:38)

holistic - an approach which views the whole person: physical, emotional, and cognitive abilities. (Yellin 1983:37)

incubation - "any technique of relaxation of the conscious cognition which allows subliminal processes to operate." (Gowan 1979:39)

lateralization - specialization of the right and left hemispheres of the brain for different cognitive functions. (Kane, 1979:158)

Lozanov method - the process of placing the body in a relaxed state by deep breathing exercises and by playing Baroque music, then listening to the information to be learned. (Yellin 1983:41)

mental imagery - "non-verbal material occurring in consciousness not immediately preceded by perceptual intake." (Gowan, 1979:39)

modality strength - "the sensory channel through which information is processed most efficiently." (Barbe and Milone 1980:45)

myelin - a fatty substance which coats the axons of a nerve cell and increases the conduction of information. (Galyean 1981 :6)

neo-cortex - the major portion of the brain (and the last part to develop) which controls the higher order skills such as learning, thinking, and problem solving. (Reifschneider 1982:21)

program - "a fixed sequence of events or instructions for events." (Reifschneider 1982:22)

proster - "a set of related programs along with a selection device which determines which program will be put into effect. (Reifschneider 1982:22)

Proster Theory of Learning - "the acquisition of useful programs." (Hart 1978:395)

style - "a pervasive quality in the behavior of an individual, a quality that persists though the content may change." (Fischer 1979:245)

Learning Styles

damaged learner - "students who are physically normal" but who develop negative learning styles due to poor self-concept, social incompetency, or other emotional problems. (Fischer 1979:250)

eclectic learner - students who have a primary learning style but who "can adapt to and benefit from other styles." (Fischer 1979:250)

emotionally involved learner - a student who needs intense emotional involvement (through colorful and vivid learning materials and/or methods or through active and open exchanges of ideas) to learn. (Fischer 1979:248)

emotionally neutral learner - a student who needs an intellectual tone, rather than an emotional one, to learn. (Fischer 1979:249)

explicitly structured learner - a student who needs clearly stated limits, goals, and behaviors to learn. (Fischer 1979:249)

incremental learner - a student who proceeds "in a step-by-step fashion, systematically adding bits and pieces together to gain larger understandings." (Fischer 1979:246)

intuitive learner - the student who uses "leaps in various directions, sudden insights, and meaningful ... generalizations derived from an unsystematic gathering of information and experience." (Fischer 1979:247)

open-ended structure - overall structure exists in the classroom but room exists "for divergence, for exploration of relevant yet not explicitly preplanned phenomena." (Fischer 1979:250)

oversensitive learner - a student who receives sensory stimuli from all sources and is unable to tune out undesired stimuli. (Fischer 1979:248)

sensory generalist - "a student who uses all or many of the senses in gathering information and gaining insights." (Fischer 1979:248)

sensory specialist - the student who "relies primarily on one sense for the meaningful formation of ideas " (Fischer 1979:247)

auditory learner - a student who relies on oral explanations, recordings, or lectures to gain information. (Fischer 1979:247)

kinesthetic learner - the student who must manipulate, write, or use tactile clues to gain knowledge. (Fischer 1979:247-248)

visual learner - the student who gains knowledge from seeing or reading about a concept. (Fischer 1979:247)

TEACHING STYLES

child centered - a teacher who "provides a structure for students to pursue whatever they want to do or whatever interests them." (Fischer 1979:251)

cooperative planner - the teacher who "plans the means and ends of instruction with student cooperation." (Fischer 1979:251)

emotionally exciting - teachers who show intense emotional involvement with the learning process. (Fischer 1979:251)

learning centered - teachers who are equally concerned with students, curricular objectives, and material to be learned. (Fischer 1979:251)

subject centered - teachers who "focus on organized content to the near exclusion of the learner." (Fischer 1979:251)

task-oriented - teachers who "prescribe the materials to be learned, demand specific performance," and keep track of individual progress. (Fischer 1979:251)

synapse - "the critical point at which two cells make contact with their dendrites." (Rose 1982:49)

synectics - "a field of educational psychology that focuses on techniques teaching metaphorical thinking." (Hatcher 1983:10)

transpersonal imagery - "going beyond the physical-emotional way of viewing oneself and the world and recognizing as valid the mystical, psychic, and spiritual dimensions." (Galyean 1983:56-57)

web - "a visual-spatial network with nodes and emanating lines which represents the connections among ideas in our mind." (Stahl-Gemake 1982:6)

ANNOTATIONS

BRAIN GROWTH AND HEMISPHERIC SPECIALIZATION

Rose, Bob, Learning Spurts and Plateaus, Educational Resource Information Center, ED 234 035, September, 1982, pp. 48-52.

Evidence concerning brain growth was presented. At birth the human brain weighed approximately one pound and consisted mainly of the brain stem which controlled basic life functions. By the age of one another pound of weight had been added in the cerebellum which controlled speaking, eating, and movement. The third pound of brain weight consisted of dendrites, tissues that connected the cells. A chemical transfer of information from one cell to another occurred at a synapse. The path that the chemical transmission followed when learning occurred formed an axon which was surrounded by a myelin sheath. Bob Rose reviewed Dr. Herman Epstein's growth spurts and plateaus and showed how in 85% - 90% of all children they corresponded to Jean Piaget's learning stages as follows:

Growth Spurt	Piaget Learning Stage
3-10 months	Cognitive response level
2-4 years	Preoperational language development
6-8 years	Concrete operations
10-12 years	Formal operations
14-16 years	Problem solving and self-awareness.

He also pointed out that girls' brains grew three times as fast as boys' between the 10-12 year spurt, but boys caught up during the 14-16 year spurt. This evidence presented grave implications for education, Rose suggested.

Ornstein, Robert E., "Right and Left Thinking," Psychology Today, May, 1973, 6:87-92.

Summarizing research on human brain functioning, Robert Ornstein concluded that the human brain was divided into two halves connected by the corpus callosum. Each half specialized in different modes of learning. The left was logical while the right was visual. However research also indicated that "the two hemispheres can function simultaneously as well as independently." (p. 88) During most daily activities it appeared that people alternated between the two modes, choosing the one most appropriate to the activity in which they were involved. Yet man's highest achievements occurred when the two halves complemented one another.

Galyean, Beverly-Colleene, "Brain Hemispheric Functioning," Roeper Review, September, 1981, 4:6-8.

After completing several research projects on cognitive learning, Dr. Galyean correlated her findings with evidence from research on brain functioning. She stated that recent research has illuminated the manner in which the brain processed information with grave implications for educators. First, thinking occurred in the brain when from ten to one hundred billion neurons exchanged information among themselves. Dendrites conducted sensory stimuli into the cell body where it was interpreted and stored. The greater the dendritic branching and the thicker the myelin coating on the axon, the faster and more fully the brain processed information. Both of these were increased by positive affective feelings and more challenging learning experiences. Second, a positive self-esteem inhibited the production of endorphins which blocked the acquisition of new information. Third, relaxed states caused an increase in the production of alpha waves which allowed greater creativity and insights. Finally, knowledge emerged within the right hemisphere, but was understood and expressed within the left hemisphere. The intellectual development of those who generally processed information in an intuitive or holistic manner was hindered by being exposed primarily to left hemispheric strategies - which have been and remain the major focus of the schools.

Kane, Nancy and Martin, "Comparison of Right and Left Hemisphere Functions," The Gifted Child Quarterly, Spring, 1979, 23:157:167.

Nancy and Martin Kane summarized thirty years findings about left and right hemisphere functions. The left brain is basically "auditory, verbal, analytic, logical, abstract, convergent, and deductive." (p. 157) The right side, on the other hand, is "visual, motoric, non-verbal, intuitive, creative, divergent, concrete, musical, spatial, holistic and inductive." (p. 157) However it appeared that the brain was flexible in the formative years and that this lateralization developed as the brain matured. Therefore educational programs in the early years which utilized both hemispheres would enhance learning and problem solving skills. Activities to stimulate both sides of the brain were included at the end of this article.

Grow, Meda F. and Johnson, Norbert, "Math Learning: the Two Hemispheres," Journal of Humanistic Education and Development, September, 1983, 22:30-39.

Researching the apparent discrepancy between the math abilities of boys and girls, Grow and Johnson set forth several facts about brain growth which had implications for educators. They stated that brain growth and development was not continuous but occurred in spurts with the greatest growth occurring between the ages of 2-4, 6-8, 10-12, and 14-16. Between these spurts were plateaus of little growth. During the growth spurts left hemispheric functions were stimulated while right hemispheric processes were better suited to the plateau periods. In addition there were biological differences between the brain growth of girls and boys. The left hemisphere developed more quickly in girls; thus they usually performed better in the early grades in school where left hemisphere functions predominated. Boys, on the other hand, had a visual-spatial (right hemisphere functions) head start. Eventually the two hemispheres caught up with each other in both boys and girls. Despite this, there was still a significant difference between the mature brain functioning of men and women. Men tended to think with one side of their brains at a time while women used both sides at the same time. Thus teachers might improve instruction by designing materials and strategies that appealed to the dominant hemisphere first and encouraged the secondary hemisphere to join in. Also new concepts would be presented during the growth periods of the brain.

Gazzaniga, Michael S., "The Split Brain in Man," Scientific American, August, 1967, 217:24-29.

The findings from a study of patients who underwent split brain surgery showed that each half of the brain was capable of advanced mental functions. The corpus callosum which connects the two halves served to integrate the operations of the two sides. When it was severed, each half of the brain had to learn each task for itself. However when the callosum was left intact, a copy of the world as observed by one hemisphere was transferred to the other in such a way that both learned together. Other evidence indicated that the left side was dominant in the adults studied, but the author believed that further research was needed to determine if this would be true in young children.

Levy, Jerre, "Research Synthesis on Right and Left Hemispheres: We Think with Both Sides of the Brain," Educational Leadership, January, 1983, 40:66-71.

Jerre Levy wrote that research was proving that some of what had been written about left and right brain learning was myth. For example he disputed these notions: that logic is "the sole province of the left hemisphere" and that creativity is "the sole province of the right hemisphere" (p. 66), that modern civilization depends only on left hemisphere functions; that people think with only one side of their brain at a time. He stated that current evidence supported the idea that children learned with both sides of the brain. The two hemispheres differed in their means of perception, but both were involved in thinking, reasoning, and appreciation of culture. Therefore, he concluded, it was essential for teachers to find a way to help students synthesize the input from both hemispheres to develop a total picture of the concept to be learned. This synthesis had to be more than the sum of the perceptions of the two hemispheres. He believed that the means to achieve this synthesis were not yet known, but it was a goal toward which teachers could strive.

Hardyck, Curtis and Haapanen, Randy, "Educating Both Halves of the Brain: Educational Breakthrough or Neuromythology," Journal of School Psychology, 1979, 17:219:230.

These authors reviewed and evaluated studies done on commissurotomy patients and right hemisphere-left hemisphere normal humans. Their contention was that too much emphasis had been placed upon these studies prematurely; and that before a great deal of money gets spent upon new curricula and tests, a closer look should be taken at the way the studies were conducted and the conclusions that were drawn. They concluded that the commissurotomy patients were not typical of normal human brain functioning and therefore no evidence from these studies should be applied to normal brain-functioning humans. They also suggested that the differences between left-right functions in experiments on normal subjects were extremely small and the tasks too simple to have much application outside of laboratory conditions. The real difference between the two hemispheres, they surmised, might be one of long term memory in which the left hemisphere might be superior for language storage. In closing they called for more evidence on hemispheric specialization before educators revised their curricula or methods.

COGNITIVE STYLE THEORIES

Gregorc, Anthony F., (Editorial) "Learning/Teaching Styles: Potent Forces Behind Them," Educational Leadership, January, 1979, 36:234-236.

"Learning style consists of distinctive behaviors which serve as indicators of how a person learns from and adapts to his environment. It also gives clues as to how a person's mind operates," stated Anthony Gregorc. (p. 234) Research has indicated that style is both nature/nurture derived. To date those who have done better in school usually have done so because they more readily adapted to the school environment. The time has come for the schools to adapt to the learning styles of the students. Currently there are instruments on the market to help determine each person's preferred learning style. However, Gregorc cautioned, these instruments should be used only as guides, not infallible prescriptions. In order to help every student learn to his full potential, teachers must use observation, as well as learning style inventories, to determine preferred learning styles and must offer a variety of methods by which students can achieve the course objectives.

Dunn, Rita and DeBello, Thomas with Brennan, Patricia, Krimsky, Jeff, and Murrain, Peggy, "Learning Style Researchers Define Differences Differently," Educational Leadership, February, 1981, 38:372-380.

Various researchers, while agreeing that individuals used different modes of learning, defined learning styles differently. According to these researchers expectations, heredity, stimuli, experience, and environment were a few of the factors involved in learning styles. Despite the disagreements over a definition, all of the researchers agreed that determining a student's particular learning style and teaching according to it were essential to developing the full capabilities of each student. They presented information about many instruments which were available to aid in determining learning styles. Many of these were self-report inventories.

Dunn, Rita, "Can Students Identify Their Own Learning Styles?" Educational Leadership, February, 1983, 40:60-62.

Rita Dunn tested more than 175,000 students in grades 3-12 to determine if they could identify their preferred learning style. She identified 21 elements in five categories which affected learning. She also reviewed studies on this same subject conducted by Domino (1970), Cafferty (1980), and Lynch (1981). According to these studies students could identify their preferred learning styles. Self-report instruments were used in all the experiments, and "investigations were then conducted to determine the accuracy of the students' perceptions." (p. 62) The findings were statistically significant. Regardless of the subject being studied the students' styles remained consistent. In addition the more closely a student's style matched the teacher's style, the better the student performed.

Price, Gary E., Dunn, Rita, and Sanders, William, "Reading Achievement and Learning Style Characteristics," The Clearing House, January, 1981, 54:223-226.

The authors conducted a study using 85 New York City elementary school children. They attempted to determine the effects of eighteen identified variables from four basic categories (stimuli, environment, emotional, physical) on reading ability levels. Eleven of the variables accounted for significant differences between high and low reading ability students. High achievement readers preferred dim lighting and a formal setting. They were self-motivated, persistent, and responsible. They did not require food while learning, but they did need opportunities for movement; they did not function well in late morning; and they were not kinesthetically motivated.

Low achievement readers, on the other hand, preferred bright lights and informal settings. They were adult motivated, functioned best in late morning, preferred a kinesthetic modality, but did not require movement during learning.

The authors concluded that to increase students' reading abilities required assessment of their learning styles and teaching methods which complemented those learning styles.

Carbo, Marie, "Teaching Reading the Way Children Learn to Read," Early Years, February, 1982, 12:43-47.

Marie Carbo proposed two basic assumptions regarding young children's learning abilities. First they were global learners, reading words and sentences more easily than the sounds of letters. Second most children were tactile/kinesthetic/visual learners, not auditory ones. Based upon these conclusions, she presented some activities to develop reading skills in a global fashion.

Carbo, Marie, "Research in Learning Style and Reading: Implications for Instruction," Theory Into Practice, January, 1984, 23:72-76.

This article cited a number of reading research studies (Dunn, Price, Carbo, Burton among others) and presented their conclusions and the implications which followed. The most basic premise was that when students were taught to read through their individual dominant learning styles, their reading achievement and attitudes improved significantly. Conversely when their learning styles were mismatched with instructional practices, their achievement declined significantly. The research indicated that the schools might be partially responsible for the number of poor readers and/or the lack of enthusiasm for reading evident among many older students. School environments were directly opposed to the dominant learning style of many poor readers. Poor readers preferred quiet, dim lighting and informal settings; they learned most easily through a holistic and kinesthetic modality; they were adult or peer oriented, rather than self-motivated; and they had high energy levels in late morning rather than early morning. If schools identified the dominant learning styles before students experienced failure, this article contended that much of that failure could be avoided by teaching according to each child's preferred learning modality.

Davidman, Leonard, "Learning Style: The Myth, the Panacea, the Wisdom," Phi Delta Kappan, May, 1981, 62:641-645.

This article critically examined the work of the Dunns and Gary Price in the area of learning styles. Mr. Davidman cautioned educators to look carefully at the evidence before jumping on the individual learning style bandwagon because there were significant differences in the hypotheses and conclusions of learning style researchers. He was especially critical of the Dunn/Price work and in agreement with David Hunt's conclusions. He pointed to several differences in the two studies. Dunn/Price viewed learning style as a consistent, static trait while Hunt viewed learning style as a trait conducive to change. Dunn/Price believed students could identify their learning styles while Hunt believed students might not really recognize their educational needs and styles. Dunn/Price relied on a computer scored Learning Style Inventory and Manual to address student differences. Mr. Davidman questioned the validity of this inventory because it was based on the assumption that individuals "possess certain consistent, enduring traits...that are difficult to change." (p. 642) Hunt, on the other hand, relied more on teacher-made questionnaires and observations and dialogue between teacher and student. A final, significant criticism of Dunn/Price was that they viewed the student as the center of the "educational universe." (p. 644) Mr. Davidman believed schools existed to serve society as well as individuals. Therefore educators must meet the needs and preferences of the community and country as a whole, not just those of the individual student.

Barbe, Walter B. and Milone, Michael N., "Modality," Instructor, January, 1980, 89:44-47.

The authors contended that modality - teaching to students' sensory strengths was the coming trend in education even though it was not a new concept. They stated that there were two factors which differentiated its use today from earlier uses: (1) it could be applied in every classroom, (2) currently there were instruments to assess modality strengths. Current research has indicated that elementary school age children could be classified in the following manner: 30 percent - visual learners, 25 percent - auditory learners, 15 percent - kinesthetic learners, and 30 percent - mixed modality. Also heredity, maturation, learning, and cultural upbringing all contributed to determining a person's modality strength. Early elementary children's strengths were more well-defined than later ones and they usually were auditorally inclined, but this shifted toward the visual and kinesthetic as they progressed through school. Finally children with mixed modalities usually did better in school because they could process information regardless of how it was presented. The authors also suggested ways to use the three modalities to teach simple concepts to children.

Torrance, E. Paul, "Hemisphericity and Creative Functioning," Journal of Research and Development in Education, Fall, 1982, 15:29-36.

Paul Torrance claimed that "educational psychologists have been slow to study the role of hemisphericity in creative functioning." (p. 30) Therefore he and his associates developed a self report instrument, "Your Style of Learning and Thinking" (SOLAT), based upon the conclusions of hemisphericity research reached in other disciplines. Seven forms of this instrument (four for adults and three for children) were developed. Each form consisted of 36 to 40 multiple-choice items in which the respondent was presented with three choices - one a right hemisphere function, one a left hemisphere function, and one an integrated process. Eight instruments for assessing creative style and four instruments for assessing creative ability were also outlined in this article as one or more of these were also given to six samples of graduate respondents of the SOLAT. Results revealed that there was "a consistent tendency for the measures of creative style to be positively and significantly related to the right hemisphere style of information processing but negatively related to the left hemisphere style." (p. 36) Results for the integrative style were inconsistent as were those for the creative ability measures. Mr. Torrance concluded that new instruments were needed to increase understanding of the relationships between learning styles and hemisphericity, but he doubted young children or adolescents were cognizant enough of their own mental processes to respond appropriately to a self report instrument.

Fischer, Barbara Bree and Louis, "Styles in Teaching and Learning," Educational Leadership, January, 1979, 36:245-251, 254.

Barbara and Louis Fischer reviewed ten learning styles and six teaching styles (see glossary under style). They contended that only those styles which were committed to instructional individualization and learner autonomy were valid and acceptable. They also cautioned that further research was needed into both teaching and learning styles and that teachers needed to observe students in the classroom situation and to adapt teaching to student preferred learning. They stated that these styles were not mutually exclusive and that some overlapping occurred. Furthermore, student interest increased any style's chances of resulting in learning. Teachers, therefore, must attempt to capture the interest of the students.

Hart, Leslie A., "The Three-Brain Concept and the Classroom," Phi Delta Kappan, March, 1981, 62:504-506.

The Proster Theory of Learning was based upon Paul McLean's description of man's triune brain. In man's evolution, the Reptilian brain developed first; the Old Mammalian, or limbic system, developed next; and the New Mammalian brain was the last to develop. Yet all three functioned as a whole in a delicate balance. Hart stated that the New Mammalian brain was huge and complex, constantly demanding variety and fresh stimuli, actively interpreting information. However this new brain was slower than the earlier evolved ones; it avoided threat by ceasing to function and allowing the faster responding Reptilian brain to take charge. Since threat was implicit in today's educational system with its emphasis on right answers, according to Hart, the newest brain was severely inhibited most of the time. Therefore learning was also inhibited. He used this reasoning to demonstrate why college entrance exam scores have declined sharply in recent years. He also claimed that a whole brain approach to education would improve student learning greatly.

Hart, Leslie A., "The New Brain Concept of Learning," Phi Delta Kappan, February, 1978, 60:393-396.

Leslie Hart presented information on the Proster Theory of Learning and his reasons for believing this to be the learning of the future. Present scientific knowledge about the brain's functioning indicated that schools were and remain brain-antagonistic. Some aspects of the brain were presented along with current educational practices which hindered learning. The human brain was seen as aggressive and individualistic, not passive; it accepted only what it needed to make sense out of its surroundings based upon its perception of reality. Therefore group instruction has not succeeded in producing learning. Each brain admitted only that which it chose to admit based upon its previous stored experiences; thus lectures and recitations were not effective learning techniques. The neo-cortex learned best by talking since it was devoted largely to language; yet many classrooms required listening, not talking. Lastly the brain was not linear and sequential, but intuitive; classrooms stressed step-by-step ordered efforts. He advocated the Proster Theory of Learning because it was brain-compatible. According to this theory learning occurred when the brain extracted meaningful patterns from the stimuli surrounding it. Therefore great amounts of stimuli needed to be provided.

Reifschneider, Thomas J., How the Brain Works: The Proster Theory of Learning, Educational Resource Information Center, ED 234 035, September, 1982, pp. 19-28.

Thomas Reifschneider summarized and agreed with Leslie Hart's theories of brain evolution and learning despite the fact that he claimed Hart developed his theory as an attack on the American schools. He accepted the concept that the brain was triune with a brain-stem which reacted rigidly and quickly to stimuli, the limbic system which controlled emotional behavior, and the neo-cortex which regulated human behavior and learning. Learning was seen as the acquisition of prosters which were linked to one another in an hierarchical order. According to the author, Hart proposed that since the function of the brain was to learn, it would do so regardless of motivation. Thinking was divided into SSM (symbol selection and manipulation) thinking which corresponded to left brain functioning and PAC (perception-analysis-choice) thinking which was intuitive and creative. Four suggestions for improving the schools were summarized and proposed as valid whether or not Hart's theories were accepted. These included removing threat from the learning environment, basing instruction on reality, utilizing SSM and PAC thinking, and providing a wide variety of learning techniques.

Helfeldt, John P., "Sex-linked Characteristics of Brain Functioning: Why Jimmy Reads Differently," Reading World, March, 1983, 22:190-196.

For at least twenty years educators have pondered why girls read better than boys. At least in the primary grades boys have seemed to have more difficulty learning to read than girls. John Helfeldt stated that the wrong question was being asked; the right question was, "Why do boys read differently than girls?" He felt that the two most common reasons given, namely: differing maturation rates between boys and girls and the cultural premise that viewed reading as a feminine task were only a part of the explanation. Another cause, which must be considered according to the author, was the biological differences in brain functioning. Recent studies were cited which indicated that boys were more visually stimulated while girls tended to be stimulated auditorally. Boys frequently activated the right side of the brain while girls activated both sides. Some implications for education were presented. However the author cautioned against accepting too simplistic an explanation for the differences between boys and girls and advised that further studies needed to be done.

Kuchinskas, Gloria, "Whose Cognitive Style Makes the Difference?" Educational Leadership, January, 1979, 36:269-271.

Gloria Kuchinskas conducted a study "to determine the effect of cognitive style on the activities in the classroom." (P. 269) Visiting 13 third- and fourth-grade classrooms over a year's time span, she interviewed teachers and students, performed tests, observed instruction, and studied records and student work. She then correlated her findings with that of other researchers such as Chall and Bennett (1976). Their conclusions were similar. "To date, cognitive style has had little or no influence on classroom instructional changes....It is almost totally ignored in the preparation and use of instructional materials except for superficial attention to auditory or visual modalities." Yet "the teacher's cognitive style influenced the learning environment more than any other factor," (p. 270) and teachers teach according to their own cognitive styles.

EDUCATIONAL IMPLICATIONS

Toepfer, Conrad F., Jr., "Curriculum Design and Neuropsychological Development," Journal of Research and Development in Education, 1982, 15:1-10.

Conrad Toepfer urged curriculum planners to work with neuroscientists and neuropsychologists to develop a continuous and progressive curriculum based upon sound principles of brain growth and hemispheric specialization. His research, conducted with Herman Epstein, proved that 85-90% of children had brain growth patterns which coincided with Piaget's learning stages (see Rose abstract this paper). Research also showed that cell replication stopped at approximately 18 months of age; all other brain growth was accounted for by increased elongation and branching of dendrites. Therefore during brain growth periods, he stated that the curriculum should challenge students to develop higher cognitive skills. Plateau periods should be used to consolidate and refine cognitive skills learned during the preceding growth spurt. Failure of schools to adapt curricula to these stages had resulted in students "turning off" to learning and developing poor self-concepts. After moving on to the next growth stage, a large percentage of students did not overcome their poor self-concepts or turn back on to learning. He believed that research had demonstrated that hemispheric specialization was not completed until puberty. Therefore early schooling must provide a greater variety of stimuli to develop both hemispheres. Thus students would be more brain-integrated with greater chance of academic success.

Galin, David M.D., "Educating Both Halves of the Brain," Childhood Education, October, 1976, 53:17-20.

The information about the brain's functioning which has been coming to light lately presents educators with grave implications, concluded David Galin. While the left hemisphere was specialized for an analytical learning style which used words as tools, the right half was specialized for a holistic style which used spatial relations. Yet he stated that these two learning modes were complementary, and both needed to be developed if creativity was to be fostered. Unfortunately the schools have focused almost entirely on the left half. The time has come for educators to develop curricula and techniques to exercise both sides of the brain.

Hatcher, Margaret, "Whole Brain Learning," The School Administrator, June, 1983, 40:8-11.

Reviewing research by such noted authorities in the field of brain functioning as Sagan, Galyean, and Hart, Margaret Hatcher stressed that the preeminent point of hemispheric specialization was balance. Despite the fact that each hemisphere had specialized functions, the brain was also bilateral; both hemispheres participated in most activities. The right brain generated new ideas and created meanings; the left organized and assimilated the new information into "already existing frameworks." (p. 9) To demonstrate that schools have emphasized logical thinking to the detriment of creativity, she quoted a study by Marilyn Ferguson which showed that creativity scores dropped approximately 90 percent from age five to age seven. This decline continued until by age 40 a person was only 2 percent as creative as at age five. Techniques to encourage creativity included synectics and multi-sensory experiential learning techniques.

Rennels, Max R., "Cerebral Symmetry: An Urgent Concern for Education," Phi Delta Kappan, March, 1976, 57:471-472.

Young children have always examined the world on a perceptual basis. However when the child started school, he was encouraged to forego sensory behaviors in favor of verbal ones. It has long been believed that children would get perceptual stimulation naturally from their environment. Thus educators have systematically eliminated experiences to develop the imagination and sensory perceptions. Since programs of the 1960's have indicated that children deprived "of visual and sensory stimuli have lower intellectual capabilities," (p. 471) it has become imperative that schools foster sensory skills as well as verbal ones.

Gregorc, Anthony F., Learning Style/Brain Research: Harbinger of an Emerging Psychology, Educational Resource Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 11-18.

Anthony Gregorc complained that education was not developing the full human potential for learning primarily because educators did not agree upon a common psychology of learning. He felt that the evidence arising from learning style/brain research could provide a framework for uniting the educational profession. However he feared that five forces could hamper this effort: (1) the present entrenched system's concept of the average child, (2) superficial or too complex presentations of the new theories, (3) incompetent or ineffective researchers, (4) the illusion of learning styles' research as a cure-all for all problems, and (5) educational purists who refuse to give credence to the new theories.

Levy, Jerre, Children Think with Whole Brains: Myth and Reality, Educational Resources Information Center, ED 227-565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 180-191.

Jerre Levy accepted the contention that each hemisphere of the brain had its specialized method of acquiring information. Yet he stressed that the evidence indicated that in all areas of study the two halves processed information simultaneously and synthesized the information to form a whole concept. Therefore he disputed the conclusion reached by some educators and researchers which claimed that school curricula were biased in favor of the left hemisphere. Further he cited a study by Joseph Hellige which demonstrated that as task complexity increased, hemispheric interaction also increased thereby enhancing performance. This evidence suggested that school tasks should be challenging to engage the whole brain and stretch the capacities of the students. In effect he refuted the current premise that schooling should be nonthreatening as nonthreatening had come to be interpreted as nonchallenging.

Mayberry, Lupita, Karr-Kidwell, P. J., Learning Styles: Their Effects on the Potential Development of the Brain, Educational Resource Information Center, ED 232 975, 1981, pp. 1-13.

Original split brain experiments carried out by Ronald Meyers and Roger Sperry in the early fifties demonstrated that the left hemisphere excelled in verbal, linear and linguistic processing while the right excelled in visual-spatial and intuitive tasks. The right hemisphere was therefore relegated to the role of minor hemisphere until more recent research emphasized its imagery functioning and synthetic information processing. The article stated that since many problems could be solved either by analysis or synthesis, both approaches to problem solving needed to be taught. To demonstrate the importance of using a global approach in teaching children, the authors presented examples of such training of children in Russia, Japan, and Uganda. Because of early stimulation and enriched environments, these children were found to be up to two years ahead of American children. They suggested that curricula be devised to meet the individual learning styles of all students because hemispheric asymmetry was common among children. While they contended that instruction should be adjusted to match the cerebral dominance of each person, activities to strengthen both hemispheres should be included.

Webb, Gertrude M., "Left/Right Brains, Teammates in Learning," Exceptional Children, April, 1983, 49:508-515.

After reviewing the research on the brain's functioning, this article stressed the need for both hemispheres to work together to fashion a complete, rounded view of the world. A list of implications this knowledge should have for teachers was included. Some of these were: the right brain's abilities should be incorporated into our curricula; learners do better when both brains are used cooperatively, so activities utilizing both halves should be planned; teacher training should include understanding of brain functions; teaching activities should be introduced through the learner's preferred mode; a task introduced visually should then be translated into language to prevent school failures.

Sinatra, Richard, "Brain Research Sheds Light on Language Learning," Educational Leadership, May, 1983, 40:9-12.

The evidence in this article indicated that language development depended on the integration of the right and left hemispheres. Unfortunately, Richard Sinatra claimed, the educational system has emphasized the left (verbal) hemisphere over the right (spatial) hemisphere. Because of this emphasis, some children who have needed visual/motor experiences to learn have been handicapped. This has been especially true for young children and continues to be a problem today. Therefore educators need to incorporate spatial experiences in the learning process.

Lindelow, John, The Emerging Science of Individualized Instruction, A Survey of Findings on Learning Styles, Brain Research, and Learning Time with Implications for Administrative Action, Educational Resources Information Center, ED 229 827, 1983, pp. 3-20, 26-36.

In Chapter One John Lindelow cautioned that the learning style theory field was still in the formative stage of development. Yet enough research had been conducted to allow practitioners to implement some of the findings. Educators must make judgments on how closely to match teaching/learning styles. Then other styles must be introduced to develop flexibility.

Chapter Two discussed brain functioning. The brain was described as a model builder. Quoting Wittrock, the author said that the brain "functions to make sense out of reality by applying models to it." (p. 18) Another quote from Wittrock to explain why students acquire different information from the same stimulus said, "Students learn and remember only what they actively construct mentally during teaching and studying." (p. 18)

Chapter Four dealt with implications for administrative action. It presented eight steps to individualizing instruction based upon learning styles.

Blakeslee, Thomas R., Brain Behavior Research, Educational Resources Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 192-199.

This article reviewed and corroborated the research on split brain studies. It then cautioned that a great danger in the learning style's concept was the possibility of one-hemisphere development. Discovering a child's preferred mode of learning must not lead to development of only that modality. Instead Thomas Blakeslee stressed that activities to develop interaction between the two modes of thinking should be employed.

Wittrock, M. C., "Editorial," Educational Leadership, October, 1981, 39:12, 15.

M. C. Wittrock proposed several educational implications based upon recent research on the human brain. His most important contention was that "learning is a generative process." (p. 12) By this he meant that students must actively build new concepts upon their previous knowledge and experiences. Another contention was that each student had a characteristic process for encoding and remembering information. Therefore students might learn different concepts from the same event or stimuli. Furthermore teaching techniques needed to match the students' aptitudes or "compensate for their lack of aptitudes." (p. 13) He believed that as further knowledge about brain functions became known, remedial treatments could be devised to build on existing functions. While teachers had the responsibility to appropriately guide and motivate learners, students were responsible for attending to the information and encoding it for long term memory. Because the brain was more sophisticated and complicated than most instruction, Mr. Wittrock suggested that a variety of methods should be employed to engage it fully. Repetition would lead to a loss of interest and attention. In conjunction with this, educational instruction should correspond to the growth and developmental stages of the brain. Finally educational researchers, neuropsychologists, behaviorists, and other related researchers should work together to improve the quality of education.

Shannon, Maureen and Rice, Dale R., "A Comparison of Hemispheric Preference Between High Ability and Low Ability Elementary Children," Educational Research Quarterly, Fall, 1983, 7:7-15.

Thirty-seven high ability (gifted) and thirty-three low ability elementary school children were tested using the Your Style of Learning and Thinking, Form C-A to determine their hemispheric preferences. The results showed that the low ability students had either a right-brain or a left-brain preference while the high ability students preferred an integrated response. The implications of this study suggested that schools and educators needed to provide methods of learning which engaged both hemispheres of the brain in order to enable each student to maximize his intellectual potential.

Mounts, Deborah S. and Street, Steven C., Whole Brain Learning Summer School Project, Migrant Child Education - Region II, Educational Resource Information Center, ED 237-289, 1983, pp. 1-46.

This study was conducted with 200 migrant Mexican-American students in Sacramento, California. Its purpose was to determine if combining right and left brain activities would bring about significant changes in both teacher and student behaviors. Several specific objectives included academic growth in reading, math, social studies, and science; integration of teaching processes to enhance social skills and academic goals; and an increase in affective and social skills. The eight teachers participating in the study were trained beforehand in integrating right/left brain activities and in matching teaching/learning styles. Weekly meetings encouraged the sharing of experiences. Sixty-three of the students were randomly selected and followed throughout the seven weeks' program. Through classroom observations, student and teacher anecdotal remarks, and pre/post testing, it was determined that forty-four students showed improved academic scores and achieved improvement in attitude and affective development. Teachers also experienced professional growth as evidenced by their self-evaluations and classroom observations.

Straham, David B. and Toepfer, Conrad F., "The Impact of Brain Research on the Education Profession: Agents of Change," Journal of Children in Contemporary Society, Fall/Winter, 1983, 16:219-233.

The authors suggested that a neuropsychology of learning be developed by synthesizing neurological data on brain functioning with psychological theories of learning. Such data would allow curriculum developers to devise programs which corresponded to the various developmental stages of processing information. They also discussed and recommended the use of computers to match teaching and learning. Due to the rapidly accelerating accumulation of knowledge, they contended that the survival of the human species might depend upon "...how well we educate our youth as effective thinkers." (p. 231)

Barr-Johnson, Virginia, "Challenging the Right Side of the Brain," Creative Child and Adult Quarterly, Winter, 1982, 7:218-225.

The author conducted a study which compared sets of drawings by elementary school students both before and after they were stimulated by viewing colorful Oriental art products. A comparison of the results indicated increased ability in color, texture, and design after their sensory stimulation, thus demonstrating an ability to develop the right side of the brain. The data also correlated with Epstein and Toepfer's theory regarding growth spurts and plateaus. The greatest gain was made by grade six students (a brain growth stage) while the smallest gain was made by fourth graders (a plateau stage). Based upon the evidence the author concluded that the arts were important in the development of right brain skills such as visualization, creativity, and intuition.

Myers, John T., "Hemisphericity Research: An Overview with Some Implications for Problem Solving," Journal of Creative Behavior, Third Quarter, 1982, 16:197-211.

John Myers researched studies on hemisphericity and agreed with Hardyck and Haapanen (see abstract this paper). He then cautiously applied the evidence to problem solving techniques. "In reality, man's brain is a unified whole" and there is considerable "sophisticated activity across the corpus callosum." (p. 208) He suggested that it was possible for each individual to integrate the artist and the scientist within himself by developing both imagination and visual thinking skills. He contended that teachers who remained aware of these different styles of processing information within individuals were more likely to incorporate a greater variety of activities within their classrooms with positive results in developing problem-solving skills.

Thomson, Scott D., Next Steps, Educational Resources Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 222-228.

Scott Thomson insisted that it was time for education to become a confident and mature profession. This could be achieved by formulating an integrated theory of learning based upon the brain research to date and by creating instructional methodology to support this theory. He suggested six next steps for the profession to take: (1) to "maintain the vision that schools can become better places for students to learn than they are now;" (p. 224) (2) to improve teacher preparation in the area of brain research/learning styles; (3) to continue research on mind/brain functions; (4) to scientifically apply mind/brain research findings in school settings; (5) to create comprehensive, yet practical, instruments to determine how students learn; (6) to expand information networks so that educators and researchers can keep in close communication with one another. He also emphasized that a variety of activities should not be introduced into the classroom just for the sake of novelty. Rather variety should "respond to each student's particular approach to assimilating information." (p. 226)

RIGHT BRAIN ACTIVITIES

Galyean, Beverly-Colleene, "Guided Imagery in the Curriculum," Educational Leadership, March, 1983, 40:54-58.

Because research seemed to validate the idea that "thinking in pictures precedes thinking in words" (p. 54), Beverly-Colleene Galyean contended that some educators were using imagery activities to improve mental functions in two ways: in preparation for learning and in subject matter content. In elementary schools she stated that imagery fell into one or more of these categories: guided cognitive which developed thinking skills, guided affective which deepened awareness and acceptance of self and others (thereby improving self-concept and learning), and guided transpersonal which promoted harmony with the universe. Research in this area indicated that imagery expanded intellectual capabilities and increased interest in the subject under consideration. She believed that further research to refine imagery uses was needed. Yet she also contended that current evidence has demonstrated that its use enabled students to experience new ways to process information and to be more creative.

Garrett, Susan, "Putting Our Whole Brain to Use: A Fresh Look at the Creative Process," Journal of Creative Behavior, Fourth Quarter, 1976, 10:239-249.

"The creative process is the transformation of a creative impulse...into a communicable product" (p. 241), stated Susan Garrett. The two hemispheres must work together to form each new idea or work of art. Everyone has the potential to use the right brain to turn his dreams into realities. In the classroom the arts should be the primary means to develop the right hemisphere, she proposed. Yet they have frequently been the first area to be cut when time or money was short.

Gowan, John Curtis, "The Production of Creativity Through Right Hemisphere Imagery," Journal of Creative Behavior, First Quarter, 1979, 13:39-51.

Creativity was an outcome of right hemisphere functioning, according to John Gowan. The left hemisphere of the brain was concerned with convergent thinking while the right used divergent thinking. After reviewing descriptions of creative breakthroughs by artists and scientists, such as Einstein, Poincare, and Brahms, he enumerated some key elements common to creativity. Most importantly he saw creativity as dependent upon curtailing left hemisphere functions and allowing the right hemisphere to dominate. A precondition for creativity was mastery of a particular discipline followed by incubation and the generation of mental imagery. He claimed that many intelligent people were never creative or not creative at will because they failed to block left hemispheric processes. According to this article, education could teach the mechanics of the creative process and should do so.

Shuman, R. Baird, Fantasy and the Brain's Right Hemisphere, Educational Resources Information Center, ED 236 628, 1981, pp. 1-12.

R. Baird Shuman postulated that the use of fantasy literature in schools could provide children with opportunities to engage their whole brain because it demanded visualization. He also contended that such literature was natural since most children had been exposed to it from infancy on in the form of nursery rhymes and fairy tales. According to this author storytelling and reading activities should progress from fairy tales, myths and fables in the early grades to legends, hero myths, and science fiction in junior high. Such literature, he believed, would encourage children to move from linear thinking (a left brain activity) to synthesizing ideas and holistic thinking. It would also make them aware that right brain learning was as valuable as left brain learning. He included titles of fantasy literature which he felt could be used at each level of educational development.

Stahl-Gemake, Josephine, Wielan, O. Paul, and Sinatra, Richard, The Right Brain: An Active Partner in Written Literacy, Educational Resource Information Center, ED 228 610, December, 1982, pp. 1-9.

This paper briefly reviewed research from the last twenty years on brain functioning and learning and applied it specifically to reading and writing activities. Reading and writing could be enhanced by appealing to both hemispheres of the brain, but current educational practice nearly ignores the right hemisphere. "While the left brain analyzes sequentially the phonemes of our language and names or reads words, the right brain produces the images, feelings, and associations connected with the words." (p. 4) To integrate processing of information by both hemispheres a graphic configuration called a web was developed. Sample webs were included to demonstrate how they could be used to help students visualize new information to predict story events, and to build vocabulary. The right hemisphere of the brain was engaged by the visual-spatial design of the web while the left brain processed the verbal information within it, thus integrating the two approaches and assuring success in reading.

Roberts, Nancy M., "Imagery: A Second Look: Expanding Its Use in the Classroom," Reading Improvement, Spring, 1983, 20:22-27.

Recent research has indicated that imagery, a right hemisphere process, may be a very useful learning tool in a wide variety of subjects. People remember better if they see a picture of an object than if they see only its name. Imaging could provide such pictures. Instructions for imaging needed to be individualized to match the learner's ability. Imagery could be useful in developing social skills through role playing; in identifying career options through visualizing the future; in creative endeavors such as music composition, writing, and drama. It could be used to progress from concrete objects to symbols in mathematics. Imagery could aid in the study of civics, social studies, history, and science through the use of fantasy and visualizing other governments and societies. According to the author, imagery was "only limited by one's imagination." (p. 27)

Yellin, David, "Left Brain, Right Brain, Super Brain: The Holistic Model," Reading World, October, 1983, 23:36-44.

For three decades researchers have discovered a great deal about how the brain functions and how people learn. Yet application of this knowledge has not found its way into schools. Recent evidence indicated that the two halves of the brain were not absolutely specialized; therefore a holistic approach must be used in learning. Three holistic approaches which could be incorporated into the educational system were biofeedback, yoga, and the Lozanov Method. These approaches used "physical relaxation, mental concentration, and belief in one's own expanded mental powers" to increase learning. (p. 43) David Yellin explained that successful experiments in several states indicated that holistic education offered great hope for increased future learning.

Steinley, Gary, Left Brain/Right Brain: More of the Same?, Educational Resource Information Center, ED 234 035, September, 1982, pp. 53-60.

Gary Steinley claimed that the furor over hemispheric specialization has had a positive result - it has caused him to analyze his teaching strategies and to make positive changes in his classroom. As a literature instructor his focus in the past had been left brain oriented, but he has begun to realize that reading is a "whole brain affair." (p. 53) He explained that part of the solution to global reading in the classroom is to allow right brain activities to share an equal role in instruction. He presented seven general areas of improvement with sample activities and practices for each. These areas included using activities that encouraged visualizing while reading, encouraging empathic reading, expanding metaphorical thinking, providing holistic responses to reading, spending time fantasizing, allowing a variety of ways to respond to the literature, and encouraging the reading of right brain oriented literature.

Wheatley, Grayson H., "The Right Hemisphere's Role in Problem Solving," Arithmetic Teacher, November, 1977, 25:36-38.

Grayson Wheatley's purpose in writing this article was to "examine problem solving from the perspective of hemispheric specialization," (p. 36) His conclusions applied to right handed individuals because they were left-brain dominant. In such persons the left brain usually processed information sequentially while the right did so holistically. The right hemisphere "thought" in images while the left "thought" in words. When applied to problem solving, the left hemisphere sought to analyze the problem, but the right grasped the whole and solved the problem at once. Referring to Bob Samples' study of how children solved problems, Mr. Wheatley stated that left alone children passed through three stages: (1) They indirectly played with the problem (right hemisphere involvement). (2) They rapidly applied a chosen method to solve the problem (left hemisphere involvement). (3) They reflected on it (basically right hemisphere involvement). He concluded that greater use of the right hemisphere could enhance problem solving.

Brandwein, Paul and Ornstein, Robert, "The Duality of the Mind," Instructor, January, 1977, 86:54-58.

The authors contended that the two modes of learning did not need to be opposites; they operated at the same time and supported each other. To cultivate creativity, each mode had to be developed. Then the mode which was not appropriate to the task at hand needed to be inhibited, or both modes could be used at once to complement each other. The article then suggested some means to develop the right hemisphere in students in the classroom, namely:

- -by encouraging holistic assimilation of evidence or events,
- -by encouraging divergent thinking,
- -by using interrogative rather than declarative statements,
- -by cultivating intuitive, as well as sequential, problem solving,
- -by encouraging subtle or primitive expressions
- -by broadening categories to develop holistic thinking,
- -by allowing longer think time for answers, and
- -by providing ample time for gathering evidence and information.

SUMMARY

A review of the research indicated that the brain was a very complex organ - more complex than the most sophisticated computer. (Hatcher) At birth the brain weighed approximately one pound and consisted primarily of the brain stem which controlled basic life functions. (Rose) By age one another pound of weight had been added in the cerebellum which controlled speaking, eating, and movement. (Rose) The last pound of brain weight consisted of dendrites. (Toepfer, Rose)

Learning occurred in the brain when from ten to 100 billion neurons interacted (Galyean:1981) by transmitting information across synapses between the dendrites. (Galyean:1981, Rose) The greater the dendritic branching and the thicker the myelin coating, the faster and more fully the brain processed information. (Galyean:1981) Evidence indicated that the myelin coating could be increased by positive affective feelings and more challenging learning experiences. (Galyean:1981) In addition endorphins which blocked the acquisition of new information could be inhibited by a positive self-concept. (Galyean:1981)

Research further indicated that brain growth was not constant and continuous. In 85-90% of all children, brain growth proceeded in spurts which corresponded to Piaget's learning stages as follows:

Growth Spurt	Piaget Learning Stage
3-10 months	Cognitive response level
2-4 years	Pre-operational language development
6-8 years	Concrete operations
10-12 years	Formal operations
14-16 years	Problem solving and self-awareness

(Rose, Grow, Toepfer)

Between these spurts were plateaus of little growth. (Grow)

Evidence derived from research on commisurotomy patients indicated that the brain consisted of two hemispheres each of which processed information differently. The left hemisphere which was stimulated during growth stages (Grow) was auditory, abstract, convergent, deductive, (Kane) analytic, (Galin) verbal, (Mayberry) and logical (Ornstein:1973). It was dominant in most right handed adults. (Gazzaniga)

The right hemisphere, on the other hand, was motoric, creative, inductive, (Kane) visual, intuitive, (Mayberry) divergent, spatial, and holistic. (Galin) Its development was hindered by over exposure to left hemispheric strategies. (Galyean:1981) Brain lateralization developed with maturity (Gazzaniga) and was not complete until puberty. (Toepfer)

Connecting the two hemispheres was the corpus callosum which integrated information from the two halves. (Ornstein) The right side created meanings and generated new ideas while the left organized the information and assimilated it into "already existing frameworks." (Hatcher:9) New concepts were formed from the synthesis of the two hemispheres. (Levy:1983)

Two researchers disputed some of the findings on hemispheric specialization. Hardyck and Haapanen concluded that commisurotomy patients were not typical of normal brain-functioning humans, and therefore, information gained from studying them should not be applied to normal people. Further, the differences between left/right functions in experiments on normal people were too small and the tasks too simple to be useful outside of laboratory conditions.

The implications brain functioning and lateralization presented education could not be understood without looking at cognitive style. Gregorc said, "Learning style consists of distinctive behaviors which serve as indicators of how a person learns from and adapts to his environment." (Gregorc 1979:234) Many other researchers defined learning style differently; yet all agreed that there were different styles, and students should be taught accordingly. (Dunn:1981) Five major categories affecting style were identified: expectations, heredity, stimuli, experience, and environment. (Dunn:1981)

Three modalities to which most researchers felt teachers gave lip service were kinesthetic, visual, and auditory. Fifteen percent of the elementary children were found to be primarily kinesthetic learners. (Barbe) Young children and low achievers were usually primarily kinesthetic. (Price, Carbo:1984) Thirty percent of elementary children were visual while twenty-five percent were auditory. (Barbe) The last thirty percent of elementary children had mixed modalities and usually did well in

school because they could process information regardless of the way it was presented. (Barbe)

Another cognitive theory which has not yet received wide support was the Proster Theory. It was based upon Paul MacLean's triune brain research. This theory proposed that man's brain consisted of three brains functioning as a whole. The Reptilian brain was the first to evolve and consisted mainly of the brain stem which reacted rigidly and quickly to stimuli. The Old Mammalian brain, or limbic system, developed next and controlled emotional behavior. Finally, the New Mammalian brain, or neo-cortex, developed. It was complex and constantly demanded fresh stimuli. (Hart:1981, Reifschneider) Because the neo-cortex was slower than the other two, it avoided threat (implicit in today's educational system with its emphasis on right answers) by ceasing to function and allowing the Reptilian brain to take charge. (Hart:1981)

In this theory learning was the acquiring of prosters which were linked to one another in an hierarchical order. (Reifschneider) Because the brain was aggressive, not passive, it accepted only what it needed to make sense out of its surroundings. (Hart:1978) Since its function was to learn, it would do so regardless of motivation. (Reifschneider) Therefore information needed to be presented to each brain according to its preferred modality. (Hart:1978)

All of these theories held the educational system at least partially responsible for the lack of student learning. The classroom environment was seen as opposed to the way many

students learned best. It was almost totally left brain-oriented (Galin) stressing linear and sequential thinking, yet the brain was intuitive. The classroom required listening while the brain learned best by talking. (Hart:1978)

A study of good and poor readers indicated that good readers' characteristics matched most classroom settings while poor readers did not. Poor readers preferred dim lighting and an informal setting. (Price, Carbo:1984) They were adult motivated, kinesthetic, and had surges of energy in the late morning. (Price, Carbo:1984) Good students had integrated styles while poor students were either left brain or right brain oriented (Shannon)

Some other factors affecting learning style were the culture, sex, and age of the student. The urban poor (usually minorities) were right hemisphere oriented (Wheatley), thus they did poorly in the left hemisphere oriented schools. Girls developed their left hemisphere more quickly than boys and were more auditory learners while young boys were basically visual. (Helfeldt, Grow) Therefore girls did better in the early grades in school. (Grow) Younger children tended to be kinesthetic and visual, not developing an auditory modality until approximately sixth grade. (Carbo:1982)

A study of teaching style revealed it to be the most important influence on the learning environment. (Kuchinskas) Matching teaching/learning styles brought about improved attitudinal changes and increased achievement. (Carbo:1984,

Dunn:1983) Lack of matching styles hindered learning. (Carbo:1984)

Many instruments have been devised to determine learning styles. Most of these, such as Dunn's Learning Style Inventory (Dunn, 1981) and Torrance's Your Style of Learning and Thinking (SOLAT) (Torrance) were self-report inventories while others, such as Hunt's Teacher Assessment of Student Learning Styles (Dunn:1981) depended upon observation. Dunn's study indicated that all students could identify their learning styles. (Dunn:1983) However, other researchers disputed this. (Davidman, Torrance, Gregorc:1979) They suggested that until further research was conducted and better instruments were devised, the present instruments should be used only as guides, not infallible prescriptions. (Gregorc:1979)

IMPLICATIONS

All of the information regarding brain growth, hemispheric specialization, and cognitive style presented education with several implications. First education has not developed the full human potential for learning because educators have not agreed upon a common psychology of learning. (Gregorc:1982) This could be corrected by interaction between educators and curriculum planners with neuroscientists and neuropsychologists. (Toepfer, Wittrock) Education should become a mature profession by formulating an integrated theory of learning based upon brain research and creating an instructional methodology to support it. (Thomson)

Teacher training should include an understanding of brain functions. (Webb) Teachers who were aware of the two modes of thinking would incorporate a greater variety of activities in their classrooms. This would bring positive results in problem solving. (Myers)

Believing they would come naturally from children's environments, schools have systematically eliminated experiences to develop imagination and sensory perceptions in favor of verbal ones. (Rennels) Studies indicated that between the ages of 5 and 7, creativity dropped approximately 90%, and by age 40 only 2% remained. (Hatcher) Challenging tasks which engaged the whole brain needed to be employed. (Levy:1982)

Since hemispheric asymmetry is common among children, curricula were needed to meet individual learning styles. (Mayberry) Concepts to be learned should be introduced through the students' preferred mode; then activities to engage the other hemisphere should be added. (Webb, Grow) The student's preferred modality must not be exclusively addressed in learning. (Blakeslee) Rather flexibility must be developed through a variety of approaches. (Lindelow) Students improved academically and attitudinally when left/right activities were integrated in the learning environment. (Mounts)

Approaches to learning needed to be varied according to the age and brain growth of the students. Curriculum developers could devise programs which corresponded to the students' developmental stages of processing information. (Straham) During brain growth stages students should be challenged to

develop higher cognitive skills. They should refine and consolidate these skills during plateau periods. (Toepfer) Insistence upon movement to higher cognitive levels during plateau stages permanently turned off a large percentage of students. (Toepfer)

CONCLUSIONS

Much about how the human brain functions has been discovered through research conducted during the last twenty years. The brain's capacity for knowledge and creativity appears to be infinite. While further research will continue to reveal even more about its processes, enough is known now for educators to begin implementing this knowledge into the educational system.

Unfortunately the same cannot be said about learning style theories. At this time the only point on which educational researchers agree is that everyone should be taught according to his particular learning style. Further research in this area is obviously needed.

There is disagreement also about the instrument to be used to determine an individual's learning style. Some researchers, such as Rita Dunn and Gary Price, believe strongly in self-report techniques. Others, such as David Hunt and Ramirez and Castaneda, believe children are not aware enough to determine their own style and teacher observation is needed. Further research is also warranted here.

Despite the lack of agreement, however, enough is known to allow educators to begin making changes in the classroom. Self-report techniques coupled with careful observation can reveal a preferred learning style. A variety of strategies and activities exist which, when incorporated into the classroom, can appeal to and challenge all students.

RECOMMENDATIONS

It is recommended that:

1. Educators work with neuropsychologists to develop a comprehensive psychology of learning.
2. Teacher training programs include a thorough understanding of brain functioning, hemispheric specialization, and learning styles.
3. Teachers develop a repertoire of teaching strategies and activities.
4. Schools provide a flexible learning environment.
5. Students and parents be informed of brain functioning and learning styles.
6. A systematic form of learning style diagnosis be developed and implemented.
7. Curricula be devised which correspond to brain developmental stages.
8. A global curriculum be devised and implemented to develop the whole person.

GENERAL RIGHT BRAIN ACTIVITIES

The following techniques can be used in any classroom for any subject at any age to engage the right brain and promote holistic learning.

1. Imagery expands intellectual capacity and increases interest in the subject. (Galyean:1983)
2. Visualization mentally sees the concept before discussing or writing. (Roberts)
3. Role Playing engages emotions as well as the mind. (Roberts)
4. Creativity uses the arts to generate mental images which can be communicated in a product. (Garrett, Gowan)
5. Metaphorical Thinking generates mental pictures. (Steinley)
6. Webs' visual-spatial designs engage the right hemisphere while the left processes the verbal information. (Stahl-Gemake)
7. Biofeedback, Yoga, and the Lozanov Method "use physical relaxation, mental concentration and belief in one's expanded mental powers" to increase learning. (Yellin:43)
8. Problem Solving engages the right brain in devising possible solutions and the left in choosing and applying just one solution. (Wheatley)
9. Divergent Thinking encourages creativity by allowing many possible solutions. (Brandwein)

10. Interrogative Statements encourage more thinking than do declarative ones. (Brandwein)
11. Intuitive Problem Solving should be seen to be as valid as sequential problem solving. (Brandwein)
12. Think Time for answers should be lengthened. (Brandwein)
13. Ample Time to gather evidence and information should be encouraged. (Brandwein)

BIBLIOGRAPHY

Barbe, Walter B. and Milone, Michael N., "Modality," Instructor, January, 1980, 89:44-47. (6, 17, 35, 36, 48)

Barr-Johnson, Virginia, "Challenging the Right Side of the Brain," Creative Child and Adult Quarterly, Winter, 1982, 7:218-225. (27)

Blakeslee, Thomas R., Brain Behavior Research, Educational Resources Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 192-199. (25, 39)

Brandwein, Paul and Ornstein, Robert, "The Quality of the Mind," Instructor, January, 1977, 86:54-58. (32, 42, 43)

Carbo, Marie, "Teaching Reading the Way Children Learn to Read," Early Years, February, 1982, 12:43-47. (15, 37)

"Research in Learning Style and Reading: Implications for Instruction," Theory Into Practice, January, 1984, 23:72-76. (16, 35, 37)

Davidman, Leonard, "Learning Style: The Myth, the Panacea, the Wisdom," Phi Delta Kappan, May, 1981, 62:641-645. (16, 38)

Dunn, Rita and DeBello, Thomas and Others, "Learning Style Researchers Define Differences Differently," Educational Leadership, February, 1981, 38:372-380. (14, 35, 38)

Dunn, Rita, "Can Students Identify Their Own Learning Styles?" Educational Leadership, February, 1983, 40:60-62. (15, 37, 38)

Fischer, Barbara Bree and Louis, "Styles in Teaching and Learning," Educational Leadership, January, 1979, 36:245-251, 254. (6, 7, 8, 9, 18)

Galin, David, M. D., "Educating Both Halves of the Brain," Childhood Education, October, 1976, 53:17-20. (1, 4, 21, 34)

Galyean, Beverly-Colleene, "Brain Hemispheric Functioning," Roeper Review, September, 1981, 4:6-8. (2, 5, 6, 11, 33, 34)

"Guided Imagery in the Curriculum," Educational Leadership, March, 1983, 40:54-58. (4, 9, 28, 42)

Garrett, Susan, "Putting Our Whole Brain to Use: A Fresh Look at the Creative Process," Journal of Creative Behavior, Fourth Quarter, 1976, 10:239-249. (29, 42)

Gazzaniga, Michael S., "The Split Brain in Man," Scientific American, August, 1967, 217:24-29. (12, 34)

Gowan, John Curtis, "The Production of Creativity Through Right Hemisphere Imagery," Journal of Creative Behavior, First Quarter, 1979, 13:39-51. (4, 5, 29, 42)

Gregorc, Anthony F., (Editorial) "Learning/Teaching Styles: Potent Forces Behind Them," Educational Leadership, January, 1979, 36:234-236. (14, 35, 38)

Learning Style/Brain Research: Harbinger of an Emerging Psychology, Educational Resources Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 11-18. (22, 38)

Gross, Meda F. and Johnson, Norbert, "Math Learning: the Two Hemispheres," Journal of Humanistic Education and Development, September, 1983, 22:30-39. (12, 34, 37, 39)

Hardyck, Curtis and Haapanen, Randy, "Educating Both Halves of the Brain: Educational Breakthrough or Neuromythology," Journal of School Psychology, 1979, 17:219-230. (13)

Hart, Leslie A., "The New Brain Concept of Learning," Phi Delta Kappan, February, 1978, 60:393-396. (6, 19, 36, 37)

"The Three-Brain Concept and the Classroom," Phi Delta Kappan, March, 1981, 62:504-506. (18, 36)

Hatcher, Margaret, "Whole Brain Learning," The School Administrator, June, 1983, 40:8-11. (2, 4, 9, 22, 33, 34, 39)

Helfeldt, John P., "Sex-linked Characteristics of Brain Functioning: Why Jimmy Reads Differently," Reading World, March, 1983, 22:190-196. (20, 37)

Kane, Nancy and Martin, "Comparison of Right and Left Hemisphere Functions," The Gifted Child Quarterly, Spring, 1979, 23:157-167. (5, 11, 34)

Kuchinskas, Gloria, "Whose Cognitive Style Makes the Difference?" Educational Leadership, January, 1979, 36:269-271. (4, 20, 37)

Levy, Jerre, Children Think with Whole Brains: Myth and Reality, Educational Resources Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 180-191. (23, 39)

"Research Synthesis on Right and Left Hemispheres: We Think with Both Sides of the Brain," Educational Leadership, January, 1983, 40:66-71. (13, 34)

Lindelow, John, The Emerging Science of Individualized Instruction, A Survey of Findings on Learning Styles, Brain Research, and Learning Time with Implications for Administrative Action, Educational Resources Information Center, ED 229 827, 1983, pp. 3-20, 26-36. (24, 39)

Mayberry, Lupita and Karr-Kidwell, P. J., Learning Styles: Their Effects on the Potential Development of the Brain, Educational Resources Information Center, ED 232 975, 1981, pp. 1-13. (23, 34, 39)

Mounts, Deborah S. and Street, Steven C., Whole Brain Learning Summer School Project, Migrant Child Education - Region II, Educational Resources Information Center, ED 237 289, pp. 1-46. (26, 39)

Myers, John T., "Hemisphericity Research: An Overview with Some Implications for Problem Solving," Journal of Creative Behavior, Third Quarter, 1982, 16:197-211. (4, 27, 39)

One of a Kind: A Practical Guide to Learning Styles 7-12, Educational Resources Information Center, ED 238 856, Oklahoma State Department of Education, Oklahoma City, Oklahoma, 1983, pp. 242-273. (48, 49)

Ornstein, Robert E., "Right and Left Thinking," Psychology Today, May, 1973, 6:87-92. (1, 10, 34)

Price, Gary E., Dunn, Rita, and Sanders, William, "Reading Achievement and Learning Style Characteristics," The Clearing House, January, 1981, 54:223-226. (15, 35, 37)

Reifschneider, Thomas J., How the Brain Works: The Proster Theory of Learning, Educational Resources Information Center, ED 234 035, September, 1982, pp. 19-28. (6, 19, 36)

Rennels, Max R., "Cerebral Symmetry: An Urgent Concern for Education," Phi Delta Kappan, March, 1976, 57:471-472. (1, 2, 22, 39)

Roberts, Nancy M., "Imagery: A Second Look: Expanding Its Use in the Classroom," Reading Improvement, Spring, 1983, 20:22-27. (30, 42)

Rose, Bob, Learning Spurts and Plateaus, Educational Resources Information Center, ED 234 035, September, 1982, pp. 48-52. (4, 9, 10, 33, 34)

Shannon, Maureen and Rice, Dale R., "A Comparison of Hemispheric Preference Between High Ability and Low Ability Elementary Children," Educational Research Quarterly, Fall, 1983, 7:7-15. (2, 26, 37)

Shuman, R. Baird, Fantasy and the Brain's Right Hemisphere, Educational Resources Information Center, ED 236 628, 1981, pp. 1-12. (29, 48)

Sinatra, Richard, "Brain Research Sheds Light on Language Learning," Educational Leadership, May, 1983, 40:9-12. (24)

Stahl-Gemake, Josephine, Wielan, O. Paul, and Sinatra, Richard, The Right Brain: An Active Partner in Written Literacy, Educational Resources Information Center, ED 228 610, December, 1982, pp. 1-9. (9, 30, 42)

Steinley, Gary, Left Brain/Right Brain: More of the Same? Educational Resources Information Center, ED 234 035, September, 1982, pp. 53-60. (31, 42)

Straham, David B. and Toepfer, Conrad F., "The Impact of Brain Research on the Education Profession: Agents of Change," Journal of Children in Contemporary Society, Fall/Winter, 1983, 16:219-233. (27, 39)

Thomson, Scott D., Next Steps, Educational Resources Information Center, ED 227 565, National Association of Secondary School Principals, Reston, Virginia, 1982, pp. 222-228. (28, 38)

Toepfer, Conrad F., Jr., "Curriculum Design and Neuropsychological Development," Journal of Research and Development in Education, Fall, 1982, 15:1-10. (21, 33, 34, 40)

Torrance, E. Paul, "Hemisphericity and Creative Functioning," Journal of Research and Development in Education, Fall, 1982, 15:29-36. (5, 17, 38)

Webb, Gertrude M., "Left/Right Brains, Teammates in Learning," Exceptional Children, April, 1983, 49:508-515. (24, 39)

Wheatley, Grayson H., "The Right Hemisphere's Role in Problem Solving," Arithmetic Teacher, November, 1977, 25:36-38. (32, 37, 49)

Wittrock, M. C., "Editorial," Educational Leadership, October, 1981, 12, 15. (25, 38)

Yellin, David, "Left Brain, Right Brain, Super Brain: The Holistic Model," Reading World, October, 1983, 23:36-44. (1, 4, 5, 31, 42)

APPENDIX

Reading Activities

(1) Reading *(A) Allow lip moving and subvocalizing
(K) Point to words using two fingers. (Barbe and Milone:46)

(2) Short Vowel Sounds: Use short sentences containing all the vowels.
(V) An ostrich egg is ugly.
(K) Get up and drop it.
Allow the student to perform the act. (Barbe and Milone:46)

(3) Consonant Sounds: (V) Use nouns b = baby
p = puppy
(K) Use verbs b = bend
p = poke
(Barbe and Milone:46)

(4) Fantasy Literature: (A) Natural to children since they have been exposed to it from infancy. Begin with nursery rhymes and fairy tales; proceed to myths, fables, legends, hero myths, and science fiction. (Shuman)

(5) Seeing Poems: (V) Have poems fit into the figurative shape that the poem tells about. (Oklahoma State Study:258)

Social Studies Activities

(1) Roving Reporter: (K, A) Simulate a newscast of an historical event, tape and present to others. (Oklahoma State Study:254)

(2) Understanding Scope and Sequence of Battles: (V) Use map and toy soldiers to present mock battle. (Oklahoma State Study:262)

(3) Dateline U.S.A.: (V) Place map on bulletin board; locate newspaper stories on the map at the source of the story. This can also be done with a World map. (Oklahoma State Study:263)

*A = Auditory K = Kinesthetic V = Visual

(4) Label States/Capitals: (V) Use a large map and laminated labels. Place the labels on the map in the proper locations. (Oklahoma State Study:264)

(5) Learn States/Capitals: Use appropriate clues for individual learning styles.
(V) Arkansas = Ark Can Saw
Little Rock = small pebble
(A) Noah looked out of the Ark-and-Saw a little rock.
(K) Turn them into charades
(Oklahoma State Study:269)

(6) Evening News: (A) Broadcast a day's news for a time period in history, such as the Boston Tea Party, Fall of Rome, or the attack on Pearl Harbor. (Oklahoma State Study:273)

Science Activity

(1) Insect Study: (V, A) Make a collection of insects identifying each one. Study the various body parts. Look for and study spider webs. (Oklahoma State Study Guide:268)

Math Activities

(1) Secret Messages: (V) Make a key in which a number matches a letter of the alphabet. Solve math problems; match the solution with the key to read the message. (Oklahoma State Study Guide:259-260)

(2) Puzzles: (V) Develop problem solving skills using tessellations, pentominoes, tanagrams, and soma cubes. (Wheatley:38)

Language Arts Activities

(1) Interviewing: (K, A) Students interview each other or an adult, taking notes, and writing a story or news report based upon the interview. (Oklahoma State Study Guide:254)

(2) Motivation through listening: (A) Use popular music to reinforce listening skills: e.g. contractions, initial consonants, common nouns, synonyms, antonyms. (Oklahoma State Study Guide:271)